

309.12 - Microelectromechanical Systems (MEMS)

The MEMS 5-in-1 RM is a single test chip with test structures for the measurement of dimensional and material properties with the use of five documentary standard test methods (from which its name is derived). To validate the use of the test methods, companies can compare their measurements with NIST measurements on the same test structures. The MEMS Calculator (<http://srdata.nist.gov/gateway/> with the keyword "MEMS Calculator") can be used for the calculations.

The five test methods are for measuring Young's modulus, residual strain, strain gradient, step height, and in-plane length. Eight properties are reported; the five mentioned plus residual stress, stress gradient, and beam thickness. Residual stress and stress gradient are obtained from calculations given in the Young's modulus test method. Beam thickness is obtained using the step height test method (as described in NIST SP 260-177). Therefore, five test methods are used to obtain the reported eight properties.

The instruments used for the MEMS 5-in-1 measurements are:

- an optical vibrometer, stroboscopic interferometer, or comparable instrument for the measurement of Young's modulus, and
- an interferometric microscope and/or stylus profilometer or comparable instrument(s) for the measurement of residual strain, strain gradient, step height, in-plane length, and thickness.

There are two types of chips (RM 8096 and RM 8097). RM 8096 was fabricated on a multi-user 1.5µm complementary metal oxide semiconductor (CMOS) process followed by a bulk-micromachining etch. For this RM, the material properties of the composite oxide layer are reported. Test structures, in addition to those used with the test methods, include: tensile test structures (to measure the Young's modulus of the metal2 layer), thickness test structures (to measure the thickness of all the layers in the CMOS process), and a linewidth test structure (to measure select oxide beam widths after the test structure is covered with a conductive layer). The supply of RM 8096 is limited.

RM 8097 was fabricated using a polysilicon multi user surface micromachining MEMS process with a backside etch. For this RM, the material properties of the first (poly1) or second (poly2) polysilicon layer are reported. Test structures, in addition to those used with the test methods, include: linewidth test structures (to measure the linewidth of poly1 or poly2 for select beam widths), thickness test structures (to measure the thickness of the poly1 or poly2 layer and to obtain data for stiction studies), fatigue test structures (to measure Young's modulus, ultimate strength, and fatigue of the poly1 layer), and a 2.5 mm ruler.

Additional information is available in the data files link.

Email mems-support@nist.gov for further assistance.

DISCLAIMER: The tables are presented to facilitate comparisons among a family of materials to help customers select the best SRM for their needs. For specific values and uncertainties, the certificate is the only official source.

SRM	Description	Unit Size	Layer Reported on
8096	CMOS MEMS 5-in-1 Test Chip	1 computer chip	composite oxide
8097	MEMS 5-in-1 Test Chip	1 computer chip	poly1 or poly2

- Certified values are normal font
- Reference values are italicized
- Values in parentheses are for information only